ACCESSION #: 9607170073

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Diablo Canyon Power Plant Unit 1 PAGE: 1 OF 10

DOCKET NUMBER: 05000275

TITLE: Manual Reactor Trip on Loss of Normal Feedwater Due to

Personnel Error

EVENT DATE: 6/10/96 LER #: 96-008-00 REPORT DATE: 07/10/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Cary Harbor-Senior Regulatory Services TELEPHONE: (805) 545-4348

Engineer

COMPONENT FAILURE DESCRIPTION:

CAUSE: SYSTEM: COMPONENT: MANUFACTURER:

REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On June 10, 1996, at 0106 PDT, with Unit 1 in Mode 1 (Power Operation) a manual reactor trip was initiated due to a loss of normal feedwater. On June 10, 1996, at 0203 PDT, a 4-hour non-emergency report was made to the NRC in accordance with 10 CFR 50.72(b)(2)(ii).

The loss of normal feedwater was caused by a loss of both main feedwater (MFW) pumps during recovery from a MFW and condensate system flow transient due to a load

transient bypass (LTB) signal actuation. The LTB actuation occurred when a plant protection system loop calculation processor (LCP) failed and was reset.

The root cause of this event was personnel error (cognitive) in that licensed plant operators failed to place the LTB control system in manual prior to reset of the Rack 8 LCP.

Plant operator and technical maintenance training will be revised regarding removing equipment from service for maintenance. Plant operating procedures will be revised regarding LTB recovery.

I. Plant Conditions

Unit 1 was in Mode 1 (Power Operation) at 100 percent power

II. Description of Problem

A. Summary:

On June 9, 1996, at 2146 PDT the plant protection system (Eagle 21) [JC], Rack 8, loop calculation processor (LCP) [DCC] locked up due to unknown causes. Reset of the LCP caused the analog (control signal) output of Rack 8 to go to zero for approximately 10 seconds while the digital circuitry "reset" resulting in the load transient bypass (LTB) [XC] channel to actuate. During recovery from the LTB, a main feedwater (MFW) and condensate system flow transient resulted in the trip of both MFW pumps [SJ][P].

On June 10, 1996, at 0106 PDT, with Unit 1 in Mode 1 (Power Operation) a manual reactor trip was initiated due to a loss of normal feedwater. On June 10, 1996, at 0203 PST, a 4-hour

non-emergency report was made to the NRC in accordance with 10 CFR 50.72(b)(2)(ii).

B. Background:

A loss of normal feedwater results in a reduction in capability of the secondary system to remove the heat generated in the reactor core. If an alternative supply of feedwater were not provided to the plant, residual heat following reactor trip would heat the primary system water to the point where water relief from the pressurizer would occur. Significant loss of water from the reactor coolant system (RCS) could conceivably lead to core damage. Without manual intervention, the plant protection system (Eagle 21) will trip the reactor well before the steam generator (SG) heat transfer capability is significantly reduced and the primary system variables never approach a departure from nucleate boiling (DNB) condition.

The Diablo Canyon Power Plant (DCPP) Updated Final Safety Analysis Report (UFSAR) shows that following a loss of normal feedwater, an auxiliary feedwater (AFW) supply of a total of 410 gpm to two SGs is capable of removing the stored and residual heat, thus, preventing either overpressurization of the RCS or loss of water from the reactor core.

DCPP has two motor driven (MD) AFW pumps and one turbine driven (TD) AFW pump. The AFW system pumps are started automatically

in response to a loss of normal feedwater. The pumps take suction directly from the condensate storage tank for delivery to the SGs. Each of the MD AFW pumps

discharge into two separate lines. Each of these lines supplies feedwater to a different SG and is provided with an electrohydraulic (EH) level-control valve (LCV-110 and LCV-111 for Pump 1-2 or LCV-113 and LCV-115 for Pump 1-3). The automatic control valves are interconnected with the SG level and pump discharge pressure instrumentation for automatic SG level control. The AFW pump discharge pressure control is an equipment protection feature to prevent motor overload and pump damage due to pump runout during a MFW or main steamline break. The LTB control feature is provided to actuate condensate and feedwater system valves in response to a sudden main turbine power decrease in order to increase the flow capability of the MFW system during a large load reduction transient. The LTB is actuated by a sensed decrease of turbine load greater than 5 percent per minute and a totalized load reduction of greater than 10 percent initiated from a turbine power level greater than 70 percent.

C. Event Description:

On June 9, 1996, at 2146 PDT, the Eagle 21, Rack 8, LCP locked up due to unknown causes. Plant operators responded to alarms and indications received in the control room and entered Operating Procedure (OP) Abnormal Procedure (AP) OP AP-5, "Malfunction of Protection or Control Channel."

On June 9, 1996, at 2330 PDT, plant operator confirmed the Eagle 21, Rack 8, protection system outputs were in the trip condition but did not place the affected analog control systems in manual.

On June 10, 1996 at 0030 PDT, following technical maintenance (TM) personnel, trouble shooting, and discussion with TM, the utility licensed shift supervisor (SS) authorized the reset of the Eagle 21, Rack 8, LCP.

On June 10, 1996, at 0044 PDT the Eagle 21, Rack 8, LCP was reset by TM personnel. The reset caused the analog (control signal) output of Rack 8 to go to zero for approximately 10 seconds while the digital circuitry "reset." The LTB circuit actuated as designed and initiated LTB required actuations:

1. The standby condensate and condensate booster pump set started.
2. Temperature control valve (TCV) TCV-23 opened fully to the bypass position.
3. Flow control valve (FCV) FCV-55 opened fully to the bypass

position.

4. FCV-230 opened fully to the bypass position.

5. FCV-231 and FCV-232 closed as required by the LTB actuation.

Plant operators were immediately aware of the inadvertent LTB actuation due to alarms and indications in the control room.

On June 10, 1996, at 0051 PDT, the main generator cold gas high temperature alarm activated in the control room indicating an increasing temperature. Plant operators responded by reducing load, resetting LTB, realigning of condensate valves, and placing the MFW regulating valves in the manual control mode.

On June 10, 1996, at 0102 PDT, MFW Pump 1-1 tripped due to mechanical overspeed trip device actuation due to low MFW pump suction pressure and high MFW flow demand.

On June 10, 1996, at 01 06 PDT, MFW Pump 1-2 tripped on high feedwater discharge pressure (2 out of 3) sensed at the pump discharge due to the increase in pump suction pressure and the MFW regulating valves in manual control mode.

On June 10, 1996, at 0106 PDT, plant operators initiated a manual reactor trip due to loss of normal feedwater.

On June 10, 1996, at 0203 PDT, a 4-hour non-emergency report

was made in accordance with 10 CFR 50.72(b)(2)(ii) with Unit 1 in Mode 3 (Hot Standby).

On July 1, 1996, at 0315 PDT, Eagle 21, Rack 8 initiated a failure alarm due to an LCP lockup. Plant operators responded by entering OP AP-5, with on the spot change (OTSC) dated June 12, 1996, and properly removing equipment from service prior to maintenance activities. The LCP circuit board was replaced, functionally tested, and the equipment returned to service in accordance with plant procedures. The LCP removed from Rack 8 will be returned to the vendor for component failure evaluation.

D. Inoperable Structures, Components, or Systems that Contributed to the Event:

Eagle 21, Rack 8 was locked up due to unknown causes prior to the initiation of the feedwater transient event. The LCP lockup placed the Protection Set 11 outputs in the tripped (fail safe) condition and "froze" the analog outputs at the last output condition. The "frozen" analog outputs of Rack 8 included:

1. Load transient bypass initiation and steam dump valve blocking.

2. Control board indicators for the dedicated AFW level control channel inputs.

3. AFW level control input for 1 of 2 control valves for both motor driven pumps.

E. Dates and Approximate Times for Major Occurrences:

1. On June 9, 1996, at 2146 PDT: Eagle 21, Rack 8 alarmed due to LCP lockup and plant operators entered OP AP-5.

2. On June 9, 1996, at 2330 PDT: Eagle 21, Rack 8 was placed in trip condition.

3. On June 10, 1996, at 0030 PDT: TM received authorization to reset Rack 8.

4. On June 10, 1996, at 0044 PDT: TM reset Rack 8 initiating a LTB actuation.

5. On June 10, 1996, at 0051 PDT: Main generator temperature alarms were received. Plant operators reset the LTB, realigned condensate valves, and place MFW regulating valves in manual control.

6. On June 10, 1996, at 0103 PDT: MFW Pump 1-1 tripped due to mechanical overspeed trip device

actuation.

7. On June 10, 1996, at MFW Pump 1-2 tripped due to

0106 PDT: (2 out of 3) high

discharge pressure

protection actuation.

8. On June 10, 1996, Event date/discovery date.

at 0106 PDT: Utility licensed plant

operators initiated a

manual reactor trip due

to the loss of normal

feedwater.

9. On June 10, 1996, A 4-hour non-emergency

at 0203 PDT: report was made in

accordance with

10 CFR 50.72(b)(2)(ii) with

Unit 1 in Mode 3.

10. On July 1, 1996, Eagle 21, Rack 8 alarmed

at 0315 PDT: due to LCP lockup and

plant operators

entered OP AP-5.

The LCP circuit

board was replaced.

F. Other Systems or Secondary Functions Affected:

None.

G. Method of Discovery:

The event was immediately apparent to plant operators due to alarms and indications received in the control room.

H. Operator Actions:

Licensed plant operators in the control room responded in accordance with established emergency procedures. They confirmed the reactor trip, verified proper engineered safety feature actuations, and initiated manual actions to stabilize the unit in Mode 3.

I. Safety System Responses:

1. The reactor trip breakers [AA][BKR] opened.

2. The main turbine [AA][TRB] and generator [TB][GEN] tripped.

3. The control rod drive mechanisms [AA][DRIV] allowed the control rods to drop into the core.

4. Both MD AFW pumps [BA][P] started due to the loss of feedwater.

5. Diesel Generator 1-1 [EK][DG] started on momentary bus undervoltage due to light bus loading conditions, but by design did not close onto its 4 kV bus since startup power

was available.

6. All five containment fan coolers [EK][FAN] started at their selected speed.

III. Cause of the Problem

A. Immediate Cause:

Inappropriate response to the MFW and condensate system transient conditions during recovery from an LTB condition.

B. Root Cause:

The root cause of this event was personnel error (cognitive) in that utility licensed plant operators failed to understand the effects of resetting the LCP on plant equipment.

C. Contributing Cause:

1. Personnel error (cognitive) in that utility TM personnel incorrectly informed plant operators regarding the consequences of resetting the LCP for the LTB control system.

2. Plant operating procedural guidance was inadequate for restoration of the condensate and feedwater system following an LTB actuation.

3. Plant operator training was inadequate in that the simulator condensate system was significantly different

than actual plant conditions causing operator recovery actions to an LTB actuation to be inadequate.

IV. Analysis of the Event

A. Inadvertent LTB Actuation:

An inadvertent LTB actuation is a previously analyzed Condition II event described in the UFSAR, Section 15.2.10A, "Sudden Feedwater Temperature Reduction." A reduction in MFW temperature results in an increase in reactor core power and creates a greater load demand on the RCS. The results of the UFSAR analysis for an instantaneous feedwater temperature reduction of 150 degrees F show that the reactor would remain in operation. The results of the analysis for an instantaneous feedwater temperature reduction of 250 degrees F show that a reactor trip occurs on high neutron flux. The minimum DNB ratios for both analyses are above the safety analysis limit and all acceptance criteria for the event are met.

B. Loss of Normal Feedwater:

A reactor trip due to a loss of normal feedwater is a previously analyzed Condition II event described in the UFSAR, Section 15.2.8, "Loss of Normal Feedwater." A loss of normal feedwater (from pump failures, valve malfunctions, or loss of

offsite AC power) results in a reduction in capability of the secondary system to remove the heat generated in the reactor core. If an alternative supply of feedwater were not supplied to the plant, residual heat following reactor trip would heat the primary system water to the point where water relief from the pressurizer would occur. Significant loss of water from the RCS could conceivably lead to core damage. Since the plant is tripped well before the SG heat transfer capability is reduced, the primary system variables never approach a departure from nuclide boiling (DNB) condition. The UFSAR analysis shows that following a loss of normal feedwater, an AFW supply of a total of 410 gpm to two SGs is capable of removing the stored and residual heat thus preventing either overpressurization of the RCS or loss of water from the reactor core.

C. AFW System:

A lockup in an Eagle 21 rack providing control system output (Rack 8, for example) is a failure in a safety-related system that propagates an erroneous signal and prevents desired automatic operation (level control) of two safety-related MD AFW pump discharge valves (LCV-110 and LCV-113), one for each redundant pump. During this event, both MD AFW pumps and the TD AFW were available to provide SG cooling water until the

problem was detected and corrected.

D. Summary:

The UFSAR analysis demonstrates that an inadvertent LTB bypass actuation or loss of normal feedwater do not adversely affect the core, the RCS, or the steam system since the AFW capacity is such that the reactor coolant water is not relieved from the pressurizer relief or safety valves. The automatic start of the two motor-driven AFW pumps ensured the adequate supply of AFW to a minimum of two SGs is provided for the cooldown of the RCS.

Therefore, the health and safety of the public were not adversely affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions:

1. A shift order was issued to notify plant operators to notify key maintenance personnel prior to resetting an Eagle 21 system.

2. OP AP-2, "Full Load Rejection," was revised to provide additional guidance to plant operators to accommodate a "bumpless" reset of an LTB signal.

3. OP AP-15, "Loss of Feedwater Flow," was revised to provide

additional guidance to plant operators to accommodate a "bumpless" reset of an LTB signal.

4. OP AP-25, "Rapid Load Reduction," was revised to provide additional guidance to plant operators to accommodate a "bumpless" reset of an LTB signal.

5. OP AP-5 was revised by a permanent OTSC to add more guidance for MD AFW pump operability when an Eagle 21 rack is locked up.

6. The effects of an Eagle 21 LCP lockup on similar analog control circuits was performed to confirm that the UFSAR analysis remains bounding.

B. Corrective Actions to Prevent Recurrence:

1. TM will provide a tailboard briefing to instrument technicians for this event and emphasize management expectations and procedural requirements regarding the need to ensure that instrumentation and control systems are properly removed from service prior to initiation of maintenance activities.

2. Operations will provide a tailboard briefing to plant operators for this event and emphasize management expectations and procedural requirements regarding the need to ensure that instrumentation and control systems are properly removed from service prior to initiation of

maintenance activities.

3. Technical maintenance training will be revised to include the lessons learned from this event. This training will include specific control system effects of resetting an LCP in Eagle 21 and requirements to remove equipment from service prior to initiation of maintenance activities.

4. Operator requalification training will be revised to include the lessons learned from this event. This training will include updated simulator parameters for the condensate and feedwater systems during LTB recovery.

VI. Additional Information

A. Failed Components:

None.

B. Previous LERs on Similar Problems:

LER 1-95-015, "Manual Reactor Trip Due to Loss of Feedwater Due to Design Deficiency," reported a manual reactor trip due to a MFW pump (SJ)(P)(MFP) trip on high discharge pressure. Corrective actions included replacing a failed speed probe, inspection of speed probes for both Units 1 and 2 MFW pumps, and review of the event with maintenance personnel. The corrective actions of this LER would not have prevented this

event due to the unrelated speed probe failure initiation

mechanism.

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Pacific Gas and Electric Company

Diablo Canyon Power Plant Robert P. Powers

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805/545-6000

PG&E

July 11, 1996

PG&E Letter DCL-96-144

U.S. Nuclear Regulatory Commission

ATTN: Document Control Desk

Washington, D.C. 20555

Docket No. 50-275, OL-DPR-80

Diablo Canyon Unit 1

Licensee Event Report 1-96-008-00

Manual Reactor Trip on Loss of Normal Feed o Personnel Error

Dear Commissioners and Staff:

Pursuant to 10 CFR 50.73(a)(2)(i)(B), PG&E is submitting the enclosed

licensee event report concerning a manual reactor trip on loss of normal

feedwater due to personnel error.

This event did not adversely affect the health and safety of the public.

Sincerely,

Robert P. Powers

cc: Steven D. Bloom

L. J. Callan

Kenneth E. Perkins

Michael D. Tschiltz

Diablo Distribution

INPO

1422S/DDM/N0001988

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